SELF-LOCKING END CAP

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

[0002] The present invention relates to a self-locking end cap for closing an open end of a fiber tube, a method of forming a container using the same and a container formed according to the method.

[0003] 2. Description of Related Art

[0004] Fiber tubes, which are also sometimes referred to as paper tubes or cores, are conventionally formed by spirally winding and adhesively bonding two or more continuous strips of paper or other fibrous material to each other in overlapping layers around a cylindrical mandrel and then cutting the fiber cylinder or tube thus formed to desired length. Fiber tubes are used in a variety of applications including, for example, as containers.

[0005] In order to use a fiber tube as a container, at least one (and usually both) open end of the fiber tube must be closed. A variety of closures are known in the art for closing the open end of a fiber tube. One of the most popular types is known as a self-locking end cap.

[0006] Most self-locking end caps, which are typically formed via a metal stamping operation, include a bottom wall and an integral tubular side wall that extends upwardly from the bottom wall to a top edge. The top edge is usually serrated and defines a circle having a diameter that is slightly larger than the inner diameter of the fiber tube into which the self-locking end cap is to be inserted. Thus, when the self-locking end cap is pressed into the open end of a fiber tube bottom wall first, the top edge frictionally engages the inner wall of the fiber tube, closing the end of the tube. When pressure is applied against the bottom wall of the self-locking end cap from within the interior cavity of the fiber tube (i.e., in the direction opposite the direction in which the self-locking end cap was pressed into the open end of the fiber tube), the serrated top edge to bites or digs into the inner wall of the fiber tube, preventing the removal of the self-locking end cap from the interior of the fiber tube. The top edge serves as the locking mechanism.

[0007] Self-locking end caps are often preferred over other types of end closures because they can be quickly installed without the need for special equipment or tooling and are less expensive than some other types of end closures. Unfortunately, however, conventional self-locking end caps can sometimes become dislodged from the fiber tube, particularly when heavy matter being transported within the fiber tube shifts during handling or transport and strikes the bottom wall of the self-locking end cap at a place other than in the center of the bottom wall. Off center strikes, in particular, can knock the self-locking end cap out of the fiber tube, which allows the matter being transported within the container to fall out. This is particularly problematic in the package delivery industry.

[0008] The conventional means of addressing this problem is to use a pneumatic staple gun to drive a plurality of staples through the fiber tube and the side wall of the self-locking end cap. The use of staples, while effective in retaining the self-locking end cap in the desired position, is disadvantageous because it adds an extra step to the container formation process, which takes additional time to execute, requires the use of additional equipment, and thus contributes to additional material and labor costs. Moreover, the sharp ends of the staples can present a risk of hand injury to package handlers.

BRIEF SUMMARY OF THE INVENTION

[0009] The present invention provides a self-locking end cap for closing an open end of a fiber tube that is substantially more difficult to dislodge from fiber tubes than conventional self-locking end caps and does not employ staples or other non-integral retaining means. The self-locking end cap according to the invention comprises a bottom wall, an integral tubular side wall that extends upwardly from the bottom wall to a top edge, and a plurality of barbs that project radially away from the tubular side wall at various points about its perimeter. The top edge and the plurality of barbs are arranged to frictionally engage an inner surface of the fiber tube when the self-locking end cap is pressed into the open end of the fiber tube. The barbs and top edge of the self-locking end cap bite into the inner surface of the fiber tube when force is applied against the bottom wall from within the fiber tube. The distance between the top edge and the

barbs creates a wider "biting zone", which diminishes the likelihood that the self-locking end cap will become dislodged when an off center pressure is applied to the bottom wall.

[0010] The present invention also provides a method of forming a container. In accordance with the method, a self locking end cap having a bottom wall and an integral tubular side wall extending upwardly from the bottom wall to a top edge is pressed into an open end of a fiber tube, bottom wall first. Next, a plurality of barbs are formed in the tubular side wall by punching, the barbs projecting radially away from the tubular side wall and into the fiber tube. If desired, matter can be placed into the tube and then the other open end of the fiber tube can be closed in the same manner. Alternatively, an end closure of a different type can be employed to close the other open end of the fiber tube.

[0011] The foregoing and other features of the invention are hereinafter more fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the present invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Fig. 1 is a top plan view of an exemplary self-locking end cap according to the present invention.

[0013] Fig. 2 is a side view of the self-locking end cap shown in Fig. 1.

[0014] Fig. 3 is a perspective view of the self-locking end cap shown in Fig. 1 pressed into an open end of a fiber tube.

[0015] Fig. 4 is a side view of another embodiment of a self-locking end cap according to the invention.

[0016] Fig. 5 is section view taken along the line IV-IV in Fig. 1.

[0017] Fig. 6a is a broken-away magnified view of a portion of Fig. 1.

[0018] Fig. 6b is a perspective view of the portion of Fig. 1 shown in Fig. 6a.

[0019] Fig. 7a is a broken-away magnified view of a portion of Fig. 4.

[0020] Fig. 7b is a perspective view of the portion of Fig. 4 shown in Fig. 7a.

DETAILED DESCRIPTION OF THE INVENTION

[0021] With reference to Figs. 1 and 2, a self-locking end cap 10 according to the present invention comprises a bottom wall 20, an integral tubular side wall 30 that extends upwardly from the bottom wall 20 to a top edge 40, and a plurality of spurs or barbs 50 that project radially away from the tubular side wall 30. The plurality of barbs 50 are arranged about the perimeter of the side wall 30, preferably using an equidistant spacing pattern. The top edge 40 and the plurality of barbs 50 are arranged to frictionally engage an inner surface of a fiber tube 60 when the self-locking end cap 10 is pressed bottom wall first into an open end of the fiber tube, as shown in Fig. 3.

[0022] A second preferred embodiment of a self-locking end cap 10′ according to the invention is shown in Fig. 4. In the self-locking end cap 10′ shown in Fig. 4, the plurality of barbs 50′ are arranged to project radially away from the tubular side wall 30′ in three distinct rings arranged about the perimeter of the side wall 30′. In the embodiment of the invention shown in Fig. 4, the plurality of barbs 50′ are arranged about the perimeter of the side wall 30′ in an equidistant spacing pattern in rings that are generally parallel to each other and the top edge 40′. Most preferably, the barbs 50′ in one ring are offset from (i.e., not in the same vertical alignment as) the barbs 50′ in the next succeeding ring, so that when the self-locking end cap is pressed into an open end of a fiber tube, each barb 50′ engages a portion of the inner surface of the fiber tube that has not previously been engaged by another barb 50′. It will be appreciated that the barbs can be arranged in two or more rows or in substantially random patterns provided a sufficient number of barbs are disposed about the perimeter of the side wall.

[0023] Fig. 5 shows a side sectional view of the self-locking end cap shown in Fig. 1 as taken along the line IV-IV in Fig. 1. With reference to Fig. 4, each barb 50 projects a away from the side wall 30, the farthest distance defining a point 70. All of the points 70 of all of the barbs 50 formed in the side wall 30 of the self-locking end cap 10 define a circle having a diameter that is about the same as a circle defined by the top edge 40. More preferably, all of the points 70 of all of the barbs 50 formed in the side wall 30 of the self-locking end cap 10 define a circle having a diameter that is slightly larger than the circle defined by the top edge 40, and slightly larger than the circle defined by the inner surface of the fiber tube. When sized in this manner, the barbs 50 (and the top

edge, so some degree) tend to undergo some deflection when the self-locking end cap 10 is pressed into the open end of the fiber tube 60. The deflection of the barbs 50 creates a bias or spring force, which further presses the points 70 of the barbs 50 against the inner surface of the fiber tube, and encourages them to dig into the inner surface of the fiber tube when force is applied from within the tube to the bottom wall 20. When sized in this manner, the barbs 50 also help obtain and maintain proper alignment of the self-locking end cap 10 within the fiber tube 60.

[0024] Fig. 6a is a broken-away magnified view of a portion of Fig. 1 showing a barb 50 projecting from the side wall 30. The barb 50 shown in Fig. 6a includes a bulging portion 80 and a radial edge portion 90. The radial edge portion 90 engages the inner wall of the fiber tube. Fig. 6b shows a perspective view of the barb 50 shown in Fig. 6a.

[0025] Fig. 7a is a broken-away magnified view of a portion of Fig. 4 showing a barb 50' projecting from the side wall 30'. The barb 50' shown in Fig. 7a includes a bulging portion 80' and a triangular edge portion 100. The triangular edge portion 100 includes a tip 110 that engages the inner wall of the fiber tube. Fig. 7b shows a perspective view of barb 50' shown in Fig. 7a. It will thus be appreciated that the shape of the barb is not per se critical. The barb must be configured such that an edge or a point is able to dig into or bite into the inner surface of the fiber wall. The barb also preferably projects radially away from the side wall a distance that is less than the wall thickness of the fiber tube. This precludes the barb from passing through the wall of the fiber tube and thereby presenting a hand injury hazard to package handlers.

[0026] The entire self-locking end cap is preferably formed from a single sheet of metal. The thickness of the metal used to form the self-locking end cap is not per se critical, however it is important that the self-locking end cap be sufficiently rigid to resist deformation during installation and use. Cold rolled drawn steel having a thickness within the range of from about 0.012" to about 0.050" (i.e., from about 30 to about 18 gage) is presently preferred.

[0027] The self-locking end cap according to the invention can be formed via a one-step stamping process or via a two-step process. In the one-step process, a metal blank is stamped into a forming die in a first press stage, which forms the bottom wall and the upwardly extending side wall. In a second press stage, the side wall is pierced

in appropriate locations and the barbs are pressed outwardly into the forming die. In the two-step process, a conventional self-locking end cap, such as may be purchased from Acme Spirally Wound Acme Spirally Wound Paper Products, Inc. of Cleveland, Ohio, is pierced in appropriate locations and the barbs are pressed outwardly into a forming die. Self-locking end caps according to the invention can be formed to fit within any diameter of fiber tube. The most useful and common diameters are 3", 4" and 6".

[0028] When a self-locking end cap according to the invention is pressed into an open end of a fiber tube, the plurality of barbs and the top edge of the self-locking end cap press against the inner surface of the fiber tube and thus serve to lock the end cap into the desired position within the fiber tube. The barbs and top edge tend to bite deeper into the inner surface of the fiber tube when force is applied against the bottom wall from within the fiber tube, such as occurs when matter contained within the fiber tube strikes the bottom wall of the self-locking end cap. The greater the force applied to the bottom wall from within the fiber tube, the deeper the barbs and top edge dig into the fiber tube. Furthermore, because the biting force is provided by and distributed to the plurality of barbs in addition to the top edge, the application of force at points other than the center of the bottom wall (i.e., off center strikes) does not significantly increase the likelihood that the self-locking end cap will become dislodged from the fiber tube. Accordingly, self-locking end caps according to the invention are substantially more difficult to dislodge from fiber tubes than conventional self-locking end caps, which only include a top edge that can bite into the inner surface of the fiber tube.

[0029] It will be appreciated that the self-locking end cap according to the present invention need not be retained within the fiber tube through the use of staples or other retaining means. Furthermore, there are no sharp edges or points that can create a risk of hand injury to package handlers. The self-locking end cap can be quickly installed by pressing the self-locking end cap into the open end of the fiber tube bottom wall first using simple tools such as a mallet.

[0030] Self-locking end caps according to the present invention are intended to be single-use products. However, because they are so durable, it is sometimes possible to remove the self-locking end cap from a used fiber tube by pressing the self-locking end

cap completely through the fiber tube bottom wall first and then reuse the self-locking end cap to form a new fiber tube container.

[0031] The present invention also provides a method of forming a container. In accordance with the method of the invention, at least a portion of a plurality of barbs projecting radially away from a tubular side wall of an end cap are formed after the end cap has been pressed into an open end of a fiber tube, bottom wall first. More preferably, all of the plurality of barbs projecting radially from the tubular side wall are formed after the end cap has been pressed into an open end of a fiber tube. An end closure of a containers formed in accordance with the method of the invention is substantially stronger, and thus less likely to become dislodged, than an end closure of a container formed using a conventional self locking end cap.

[0032] In accordance with the method of the invention, an end cap, which may be a self locking end cap or simply an end cap, is pressed into an open end of a fiber tube. The end cap must have a bottom wall and an integral tubular side wall extending upwardly from the bottom wall to a top edge, which may be of any configuration (e.g., serrated, non-serrated, flat, curved, rolled etc.). The end cap can have one or more barbs projecting radially from the tubular side wall when it is pressed into the open end of the fiber tube. Or, more preferably, the end cap has no barbs projecting radially from the tubular side wall when it is pressed into the open end of the fiber tube.

[0033] Next, at least one, and preferably more than one, barb is formed in the tubular side wall so as to project radially from the tubular side wall and into the fiber tube. The barb or barbs are formed by a punching operation, preferably using a pneumatic or hydraulic punching head. The barbs can be formed individually, one after another in sequence. Or, more preferably, all of the barbs formed simultaneously in a one-step punching operation. Once the barbs are formed, barb-forming pins retract back into the punching head allowing the fiber tube and end cap secured thereto to be removed from the punching head.

[0034] The end cap is preferably placed on a punching head such that the bottom wall is exposed. A fiber tube can then be pressed over the end cap covered punching head until the fiber tube is seated against a stop. The fiber tube can be pressed onto the end cap covered punching head horizontally, vertically, or at any angle between

horizontal and vertical. The punching head includes one or a plurality of pins that rapidly extend away from the punching head when pneumatic or hydraulic pressure is applied to the punching head. The pins press against the tubular side wall of the end cap and form barbs having configurations defined by the configuration of the pins. Preferably, the fiber tube and end cap fit within a die that surrounds the punching head. The die defines the maximum size and depth of the barbs, and prevents the pins (or the barbs formed by the pins) from piercing the fiber wall of the fiber tube.

[0035] The configuration of the barbs formed in the tubular side wall of the end cap in accordance with the method of the invention can be similar that shown in Figs. 6a, 6b, 7a and/or 7b. Alternatively, the barbs can have a completely different configuration. A preferred configuration is a star pattern, which includes a plurality of points that extend from a common point into the fiber wall of the fiber tube, but do not extend completely through the fiber wall to the outside of the fiber tube. Barbs having a star pattern configuration are easy to form by punching and advantageously prevent movement of the end cap in any direction (in or out of the tube).

[0036] In accordance with the method of the invention, a container is formed by pressing an end cap having a bottom wall and an integral tubular side wall extending upwardly from the bottom wall to a top edge into an open first end of a fiber tube, and then forming at least a portion of a plurality of barbs in the tubular side wall, the barbs projecting radially from the tubular side wall and into the fiber of the fiber tube. Matter can then be placed into the fiber tube through a second open end. Next, the second open end of the fiber tube is closed using a suitable end closure. The end closure used to close the second open end of the fiber tube can be, but need not be, an end cap according to the invention. If desired, a plurality of barbs can be formed in the end closure used to close the second open end of the fiber tube in accordance with the method of the invention. It is also possible to place matter within a fiber tube when both ends are still open and then secure an end cap to each open end simultaneously in accordance with the method of the invention.

[0037] Thus, a container according to the invention comprises a fiber tube and an end cap disposed in an end of the fiber tube. The end cap has a bottom wall, an integral tubular side wall that extends upwardly from the bottom wall to a top edge, and a

plurality of barbs that project radially from the tubular side wall and engage an inner surface of the fiber tube. The end cap can be a conventional self locking end cap or a self locking end cap according to the invention (e.g., such as shown in Figs. 1 and 4). Because the barbs do not extend completely through the fiber wall of the fiber tube, they present no risk of hand injury to package handlers. Moreover, the end caps of containers according to the invention do not become dislodged during transit.

[0038] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and illustrative examples shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.